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ENERGY AND SUSTAINABLE DEVELOPMENT: EFFICIENT UTILIZATION OF ENERGY RESOURCES

Means to promote and implement energy efficiency in developing countries

Report of the Secretary-General

SUMMARY

The present report has been prepared to guide the discussion of the Committee during its first session. The document outlines the basic issues and problems that are encountered when seeking to promote energy-conservation programmes in developing countries. It includes a number of recommendations for action at both the national and international levels that have been compiled by the Department for Development Support and Management Services in implementing its programme of technical cooperation.

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INTRODUCTION

1. The concept of energy conservation is a global one that encompasses multiple objectives, including conserving scarce and finite economic resources, improving the technical efficiency of energy conversion and use, substituting cheaper fuels for more expensive ones and reducing or reversing the negative impact of energy production and consumption activities on the environment.

2. Energy conservation is a rational, cost-effective and rapid way for most developing countries to reduce energy costs, stretch their energy supply base without heavy investment, save foreign exchange and contribute to the global effort of protecting the environment.

3. Energy is a scarce economic resource and therefore every effort should be made to ensure that it is utilized in the most efficient manner, particularly in energy conversion and utilization in the industrial and household sectors. Inter-fuel substitution may be employed where it will result in technological and/or environmental improvements. Both energy efficiency and environmental protection are of global concern, rising above pure national considerations, and are therefore a natural part of the agenda of international organizations and financing agencies.

I. GENERAL ENERGY-CONSERVATION POLICIES

A. National energy strategy

4. When considering the means to promote energy efficiency, it is understood that any decisions for action should be made within the framework of an integrated national energy strategy. It is the role of government to formulate policies and strategies that direct the energy sector towards an efficient and sustainable future. Decisions must be made with regard to the structure of the energy sector itself, including its institutions and their roles, ownership, financing, availability of fuels and technological choices. Energy sector strategies in developing countries range widely from subsidized public monopolies and parastatals to highly competitive private companies.

5. An energy strategy must include both supply- and demand-side options in order to ensure an energy efficient future. On the supply side developing countries should consider promoting institutional and regulatory reform and increasing the participation of private sector energy supply companies. Rehabilitation and modernization of existing plants should go hand in hand with loss reduction programmes in transmission and distribution. On the demand side, countries must establish appropriate price structures and competitive markets for consumer choices.

B. Promoting competitive markets

6. Measures to promote energy efficiency must include reduction of barriers to the development of dynamic industrial and commercial sectors operating in competitive markets. Protectionism, trade restrictions and foreign exchange controls should all be phased out. However, the political, economic and social conditions in individual countries underscore the need for a country-specific approach in addressing these issues. Countries in which private sector companies operate in competitive environments are the first to adopt technological innovation. When energy-efficient technologies are transferred to countries without competitive markets, experience shows that energy-efficiency potentials are never fully realized.

C. Institutional and regulatory reform

7. Institutional measures to promote energy-efficient supply and distribution might include such initiatives as restructuring of energy supply utilities and establishment of a transparent regulatory framework between government and energy supply enterprises. One current trend in developing countries is the shift away from large State-owned monopolistic energy utilities towards a decentralized, market-based incentive approach. This approach combined with a transparent regulatory structure provides the opportunity for energy consumers, investors, environmentalists and others to have a voice in policies related to pricing, energy conservation, environmental impacts, reliability of and access to energy services, and many other operational matters.

D. Transfer and development of energy-efficient technologies

8. The technology available to the developing countries, either transferred from the developed countries or developed locally, should be of the highest standard in terms of energy-conversion efficiency. Intermediate or outdated technologies, even when they are cheaper at the stage of initial investment, could in the long run be more expensive because of costlier operation in terms of fuel consumption and its negative impact on the environment. The transfer of technology does not always have to be North-South, but can also be South-South, thereby utilizing the experience gained in other developing countries. One overriding requirement, however, is that all technologies supplied should be well tried and proven.

9. In rural areas, modernization should be promoted but sometimes in transitional stages. Special consideration should be given to the deforestation and reforestation problems following the use, often overuse, of fuelwood and charcoal in many parts of the world, especially in Africa. Improving the efficiency of cookstoves must be paralleled by the introduction of more modern forms of energy such as electricity, liquefied petroleum gas (LPG) and kerosene, aiming at a substantial reduction in the toll on limited biomass resources.

10. Technology transfer also requires an understanding of the institutional milieu, as well as physical aspects, of projects in the developing country. In this sense, technology is not just hardware and software, but also the

supporting institutional arrangements and incentive structures. Included in this is long-term capacity-building through training of technical and managerial staff.

E. Financial requirements and mobilization of resources

11. Since capital requirements for developing countries' proposed programmes of investment far exceed the financial resources available, the best short-term option is to meet some of these needs by making better use of the equipment and resources already at hand. It is recommended that developing countries alter their investment priorities to support end-use efficiency, sustainable and reliable operations and maintenance programmes, and private sector initiatives, in addition to traditional investments in supply.

12. Bilateral and multilateral institutions should study the lack of progress in private sector involvement in the power sector of developing countries. Where possible, such institutions should expand their financing to cover joint ventures in environmentally sound electric power-related technology cooperation. In addition, it would be useful if donors and lending institutions could provide insurance for private sector power projects to enable capital mobilization from commercial and other markets.

13. Strong and effective energy demand management measures should be put into place. Financial resources should be used for the rehabilitation of existing power-generation capacity, and new equipment should be acquired only when reasonable standards with regard to the availability and efficiency of existing equipment have been met. In support of this, least-cost investment-planning approaches, incorporating the concept of life-cycle cost (LCC), should be developed and implemented in the power sector in order to give equal treatment to improved end-user efficiency, loss reduction in transmission and distribution, and rehabilitation of existing capacity in relation to constructing new generating plants.

14. A mechanism is needed to channel available financial resources towards energy-efficient equipment in all sectors. It is recommended that international and bilateral financing bodies consider financing joint venture manufacturing in developing countries as well as research and development in energy-efficient technologies and end-use devices. Similarly, it would be useful if funding could be made available to support the availability and delivery of critical spare parts to ensure high system availability.

15. To achieve such a change of attitude in planning and financing, there is a strong need for coordinated, joint action by both national and international institutions. Differences exist in attitudes and priorities among international and regional financing institutions and bilateral assistance agencies regarding the use of concessional funding for new plants versus modernization and rehabilitation of older plants. Therefore, donor collaboration in support of energy efficiency programmes needs to be developed and strengthened.

16. For their part, developing country Governments should strengthen financial mechanisms, institutions, and associated policies and regulations to provide innovative lending in supply- and demand-side power sector efficiency, including direct lending for private sector initiatives. Financing sector entities, including development financing institutions with portfolios in industrial modernization, agriculture, the environment and housing, are targets for such institutional reforms.

17. The investor community is increasingly incorporating environmental guidelines in project evaluation; compliance with existing regulations in the country is a basic requirement. In addition, the investor-partner team can draw upon information and new technologies that promote energy efficiency, which often is accompanied by reduced environmental impact. Since the energy efficiency converts to an economic incentive for the owner-operator, all parties can benefit.

F. Domestic energy pricing

18. Many developing countries continue to subsidize electricity and/or fuels heavily in the rationale that they are supporting the productive sectors of their economies. However, it is a policy that in the long run counteracts its objectives since low energy prices promote wasteful procedures, cement energy-inefficient technologies and undermine any energy-conservation programme. An inadequate inter-fuel price structure can also distort energy-consumption patterns and lead individual users to less economical fuels, or to fuels that are harmful to the environment. An internal energy-pricing policy and inter-fuel price structure address the double purpose of paying for the resources and capital used in the energy supply and giving the energy consumer a clear message about its economic value and national socio-economic policy considerations. It is recommended that this dual purpose of internal energy prices be duly considered and, if necessary, pricing policies in developing countries revised accordingly.

19. Taxes and duties on energy conservation equipment are a disincentive to energy-efficiency gains, and it is recommended that they be reduced or removed. Rapid changes in taxation and tax levels for different sources of energy cause problems for both customers and equipment suppliers in that it changes the rules of the market, sometimes too quickly. Taxation is also increasingly being used to achieve environmental ends. A guiding principle in pollution prevention is the polluter pays principle. The traditional way of inflicting pollution costs in the energy supply system is to set emission standards and requirements, forcing a certain level of investment to meet the requirements. These costs must, then, be transferred through the system to the price paid by the end consumer, giving him the right signals. The true price combined with a systems approach to new investments will then help in getting cost-effective priorities right at all levels.

G. Education and training

20. People are the key factor in the equation of a successful energy-conservation programme. Adequately skilled and motivated personnel are essential for promotion, acceptance and implementation of energy-conservation projects and practices. It is recommended that intensive training programmes and promotional campaigns targeted at different groups and levels of society be pursued in developing countries. Their objectives should be: (a) to encourage policy makers and managers to become more aware of the potential and benefits of energy conservation, and capable of establishing pragmatic conservation policies; (b) to increase the availability of technical staff skilled in energy auditing and in the application of energy-saving technologies; and (c) to keep energy users informed and motivated to include energy-conservation practices in their activities.

21. Training and promotional needs should be addressed through special courses and seminars at national, regional and international levels, and through promotional campaigns in the mass media. It is recommended that every effort be made to create satisfactory conditions, including adequate remuneration, and, through apportioning responsibilities, to retain trained personnel and encourage them to utilize the skills they possess.

H. Information needs

22. Adequate information is essential for the formulation and execution of energy-conservation programmes. Information on energy supply and demand at the sectoral level is needed in order to identify those sectors and subsectors where energy-conservation efforts should be addressed first and will have the greatest impact. Energy balances and energy-flow diagrams are needed at the plant and industrial-process levels and can contribute to sectoral energy information systems. Microcomputers combined with user-friendly software for marshalling systems information are recommended as important tools to support these information needs. It is recommended that existing national energy information systems be adapted to address the information needs of energy-conservation programmes, including their environmental implications.

I. Institutional framework

23. Although the benefits of energy conservation from the technical, economic and environmental points of view are known to many developing countries, implementation and investment in energy-conservation projects have only recently begun to gain momentum. Energy-efficiency measures identified by energy audits are being implemented only when small investments or housekeeping measures are called for. As a result, energy-conservation practices have not expanded beyond initial applications.

24. Inadequate institutional frameworks for guiding, educating and sustaining energy-conservation efforts are a primary reason for the failure of energy-conservation policies in developing countries. It is recommended that the establishment of truly effective institutions responsible for energy-

conservation promotion, education, training and provision of technical services be given a high priority by countries that have not yet done so. These energy resource and efficiency centres have a role to play in the following areas:

(a) Dissemination of information on technology options and financing;

(b) Promotion and implementation of demonstration projects for demand-side management measures and renewable energy applications;

(c) Training, information and advisory services on energy loss reduction programmes;

(d) Development of private sector energy service companies;

(e) Implementation of energy audits;

(f) Assisting Government in drafting of codes and standards for energy end-use appliances and buildings;

(g) Directing national and international technical assistance programmes directed at energy efficiency.

J. Standards and codes

25. An important element of the regulatory framework needed to promote energy efficiency is minimum standards for appliances and vehicles and appropriate building codes. Where regulation is necessary, economic incentives should be employed to achieve energy efficiency rather than attempt to legislate behaviour. Public institutions should have the power to enforce such codes and standards, but much support can be received from consumers and the general public if informational campaigns are successfully utilized. The establishment of standards requires the agreement of producers, consumers and Government; institutional mechanisms must be established for the effective enforcement of those standards, and laboratories are required to verify standards. Lack of agreement and weak enforcement mechanisms have hampered the effectiveness of standards and codes in energy-efficiency programmes.

K. Energy efficiency and the environment

26. It is well noted that the conditions of poverty in many developing countries do not allow for practical concern for the environment; thus, it is said that poverty pollutes. At present, economic development is highly dependent on the exploitation of natural resources. An urgent challenge exists to ensure that the development of these resources is carried out in a sustainable fashion. Improvements in energy efficiency and reduction of wastes and losses are among the most substantial contributions towards this goal. Energy conservation goes hand in hand with protection of the environment. Energy conservation is actually one of the most cost-effective ways to achieve environmental improvements. National programmes for environmental improvement have focused on energy efficiency as a sure way to reduce production of

greenhouse gases which contribute to global warming. It is recommended that conscientious efforts be made by energy planners and managers in the energy sector to include environmental objectives in their national energy-conservation programmes and in the overall energy-planning policies and strategies of the country.

27. There has been little substantive response to Agenda 21 in the developing countries since the United Nation Conference on Environment and Development. In part, this results from immediate needs (e.g., public health, potable water) of demonstrable benefit at the national level that compete with equally costly but more diffuse environmental objectives, in combination with resource limitations for Government. A possible consequence of Agenda 21 is the creation of some form of carbon tax. This will have considerable impact on planning processes for the power sector, industry and transport, and it will certainly spur energy-efficiency efforts at all levels.

II. ENERGY CONSERVATION IN THE POWER SECTOR

28. The objective of power system planning is to meet energy demand reliably and at minimum cost. Future electricity demand should be determined by incorporating demand-side management measures, such as peak-clipping, valley-filling and load-shifting, as well as efficient end-use. It is recommended that life-cycle-cost investment planning be developed and implemented to give equitable treatment to rehabilitation, loss-reduction and end-use efficiency.

29. The technical and economic advantages of regional power system interconnections can lead to lower overall generation costs and a need for reserve capacity and increased supply security and an expanded knowledge base in the interconnected companies. Power system interconnections may also contribute to better understanding and cooperation between the participating countries. To be successful, interconnections require political support, flexible organizations, mutual trust and direct contact between key personnel, and open information between the utilities concerned. It is recommended that interconnection opportunities in various developing countries be seriously considered and supported.

30. Proper maintenance and operation of a power system reduces losses, both technical and non-technical, and thus conserves energy. In view of the scarcity of investment capital available for installation of new and more efficient power-generation plants, it is recommended that rehabilitation be given the highest priority.

31. It is recommended that special emphasis be placed on efficiency improvements in power transmission and distribution systems. Large gains at comparatively low cost are readily available, mainly in the form of reactive power compensation systems.

III. ENERGY CONSERVATION IN INDUSTRY

32. The implementation of simple, straightforward energy-saving measures is highly effective, and these measures usually have short payback periods. To make such efforts sustainable, prerequisites include training personnel in energy-conservation techniques, keeping management well-informed about these programmes and establishing energy-auditing procedures. The designation of energy managers in the major energy-consuming industries should also be part of this strategy.

33. The first step in the energy-conservation process is an energy audit, since planning and accurate measurements are the key to successful energy management. Energy audits generate easy-to-implement, low-cost improvements that often pay for the audit immediately, increase awareness of conservation opportunities and form a basis for informed action. It is recommended that auditing programmes be initiated or strengthened to attain these benefits.

34. Heat recovery from industrial processes is an excellent energy-conservation practice. Recognizing that heavy losses are incurred in process industries owing to throttling flows from pumps and compressors, it is recommended that variable-speed drives be used in lieu of throttling, wherever possible. Payback periods for such substitutions have been demonstrated to be very short.

35. It is recommended that co-generation – the joint production of heat and power for industrial and community needs using various fuels (including biomass) – be promoted and utilized as an effective technology to improve energy efficiency. Typically, losses can be reduced from 60 to 20 per cent by co-generation, compared with a conventional condensing cycle. It is further recommended that, through appropriate legislation, co-generation be given economically viable conditions for power exchange with the public utility.

IV. ENERGY CONSERVATION IN THE HOUSEHOLD SECTOR

36. The key constraint in the planning and management of household energy conservation in the developing countries is lack of information. The decision-making process needs an interdisciplinary approach to incorporate the technical, economic and social aspects of household energy, while establishing an appropriate energy-conservation programme. Especially in rural areas, emphasis should be placed on South-South cooperation, since many years of effort in developing countries have already been invested in training and implementing projects of these kinds and the experience gained should be transferred across borders and continents.

37. Fuelwood is still the main energy source in rural households. Dwindling fuelwood resources in many developing countries are both causing hardship to rural populations and contributing to damaging effects on the environment. In addition to improved efficiency of fuelwood combustion, it is recommended that fuel-substitution measures be adopted to reduce the role of fuelwood in favour of other fuels, such as LPG, kerosene and coal, as well as solar and wind energy schemes and, above all, electrification. It is further recommended that reforestation be a priority policy in developing countries.

38. A variety of processes are available for production of charcoal, with widely varying (25-70 per cent) conversion efficiencies. The use of highly inefficient processes should be monitored, with a view to reducing their role in energy supply. At the same time, more efficient charcoal production and consumption technologies must be promoted and proper forestry management employed to mitigate the harmful environmental effects of fuelwood harvesting.

39. Much of the electricity consumption growth in developing countries, primarily in urban areas, is due to the increased use of household appliances. It is recommended that strategies be adopted to incorporate modern, energy-efficient technologies in household appliances, which are not likely to cost the consumer appreciably more.

40. Energy conservation in the housing and building sector can be improved through the adoption of appropriate building standards and codes that will help promote the use of suitable insulation, better structural design, more efficient air-conditioning, and similar features.

V. ENERGY CONSERVATION IN TRANSPORTATION

41. The transportation sector is responsible for an average of one third of the total energy demand in the majority of countries, including industrialized and developing countries. It also keeps increasing its share, while other sectors are reducing or maintaining their share in the total energy demand.

42. When comparing energy intensities (energy/ton-km or energy/passenger-km) among transport modes, it becomes clear that modal shift (e.g., from road to rail) is an important way of reducing energy consumption and still meeting the transport demand. However, energy accounting alone should not be used as the sole basis for determining the preferability of one mode over another, since each mode provides different services in terms of access, flexibility, convenience, time in transit, comfort, relative costs, safety etc.

43. Also, an analysis of comparative energy intensities alone does not reveal the total energy actually used in a particular mode. Several components have to be considered for a thorough evaluation of potential transportation energy savings, including not only propulsion energy, but also energy to operate stations and other infrastructure, maintenance, energy to construct rights-of-way and manufacture vehicles, among others. Nevertheless, if the simplest analysis were made, then energy intensities of passenger transport modes, from highest to lowest, in general terms are: air, private automobile, urban mass transit, rail (local trains) and bus. For freight transport modes, energy intensities, from highest to lowest, are: air, road (trucks), rail, waterways and pipeline. It is recommended that countries explore possibilities for urban transport such as express bus lanes and mass transit systems, including light rail and metro service.

44. Besides modal shifts, there are several other ways to improve energy efficiency in transport. Increased efficiencies in transport equipment (vehicles, engines), increased load factor and improved usage patterns are among

the main ways to conserve energy. In this regard, it is recommended that countries institute driver-training and vehicle-maintenance programmes.

45. Reduction in transport demand can also be achieved via improved telecommunications, better land-use patterns and adequate transportation planning. In terms of policy approaches, two basic options exist: direct command and control (through regulation, administrative fiat, physical constraints) and indirect control (through fiscal measures), depending on whether market prices alone may secure the desired modifications. Examples of these two options include licensing schemes and road pricing or toll collection.